JACC: CARDIOVASCULAR INTERVENTIONS
VOL. 8, NO. 6, 2015

ISSN 1936-8798/$36.00
PUBLISHED BY ELSEVIER INC.
http://dx.doi.org/10.1016/j.jcin.2015.03.009

EDITORIAL COMMENT

Twofers and Transaortic Valve Replacements*

David R. Holmes Jr, MD,† Michael J. Mack, MD‡

The concept of twofers is widely used in a variety of situations and applications ranging from cabling devices in theatrical stage lighting to Broadway tickets to 2 hamburgers for a quarter at Tucker's Twofers to items of merchandise to something that "satisfies 2 criteria or needs simultaneously." The paper by Petronio et al. (1), in this issue of *JACC: Cardiovascular Interventions*, takes this concept to a new level in the analysis of the relationship between the need for permanent cardiac pacing (or consideration of it) in the setting of a specific transaortic valve replacement (TAVR) device, the Medtronic CoreValve (Medtronic, Minneapolis, Minnesota).

SEE PAGE 837

This has been a contentious issue. In the surgical arena of surgical aortic valve replacement, the development of heart block requiring a pacemaker is considered and reported as a complication and typically occurs in 2% to 5% of patients. In contrast, the field of TAVR, as referenced in this paper, report rates of pacemakers that vary widely from 10% to as high as 47% (2–6). There are device-specific rates for the 2 most commonly used and U.S. Food and Drug Administration–approved devices in published registry experiences; one of the specific manufacturer devices has typically been associated with substantially higher rates of pacemaker implantation than the other. This discrepancy has raised the discussion of the definition of what constitutes a "complication." If the need for a pacemaker is considered to be a common and accepted part of the procedure (a twofer), that has 1 set of implications; however, if a permanent pacemaker is coded as a complication of TAVR, that has important potentially negative implications, in particular, for example, if 1 TAVR device has a substantially higher rate. This has implications for the reporting of complications for risk stratification and for reimbursement and may also have an impact on patient decisions. This consideration has led to changes in practice. It has been commented on by some that perhaps sometimes these changes may have been made to "game" the system; for example, in some centers (by report), pacemakers are implanted before the TAVR procedure so that the need for a pacemaker does not need to be recorded as a complication; in other cases, the pacemaker is implanted later, more electively, again to avoid the label of a "complication."

The present study is an important one and evaluates several important issues: 1) the rate of new permanent pacemaker implantation when placed according to Class I or II indications recommended by professional societies (7); 2) the relationship of procedural variables with the subsequent need for permanent pacemaker implantation; 3) the frequency and time course of new conduction defects; and 4) the safety and efficacy of the TAVR procedure.

A specific valve, the self-expanding Medtronic CoreValve System, was studied. A number of patient categories were excluded, which resulted in ~35% of all patients with the Medtronic CoreValve System at the representative institutions being excluded. An extremely important issue is the question "were there specific reasons why these patients were excluded and what was the pacemaker rate in that population?" The impact of this is not possible to gauge but may be important. Of the 200 patients actually enrolled, an additional 6 patients did not

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Interventions* or the American College of Cardiology.

From the †Mayo Clinic, Rochester, Minnesota; and the ‡Baylor University, Dallas, Texas. Dr. Mack is on the Steering Committee of the PARTNER trial. Dr. Holmes has reported that he has no relationships relevant to the contents of this paper to disclose.

receive the device, and then between implantation and 30 days, 11 additional patients either died or missed their follow-up endpoint (1 withdrew consent), so that the percentage of patients actually evaluated among patients treated is even smaller. A permanent pacemaker was implanted in 24.4% of patients, which, interestingly enough, is neither mentioned in the abstract nor text but only found in Table 3 (1). Importantly, the pacemaker was typically implanted during the hospital stay within the first 48 h. That has important implications for the future because the duration of hospital stay is decreasing. Beyond 48 h, there was no further incidence of complete heart block, although other conduction defects were seen. What will happen to the patients with late-onset conduction defects is not clear.

A critical portion of the paper relates to procedural performance. The Medtronic CoreValve System bioprosthesis "contains a self-expanding nitinol frame with a high radial force that interacts with tissues a few millimeters below the aortic annulus" (1). Mechanical compression at that site sets the stage for either temporary or permanent damage to the conduction system. As could be imagined, either local anatomic features such as excessive asymmetrical deposition of calcific nodules or procedural factors could affect the results and outcome of the procedure. Important findings in this study included implantation depth. By receiver-operating characteristic analysis, the optimal implantation depth was ≤4 mm, even though that was only able to be achieved in 25.5% of the patients. That depth had the best negative predictive value (93.9%), although the positive predictive value was only 21.7%. Accordingly, if that is an extremely important metric of the procedure, it is only able to be achieved in a minority of all patients and, as a goal, is less relevant with this current prosthetic design. In addition, smaller-sized devices were more frequently associated with higher rates of optimal implantation depth, although a tradeoff may be that undersized devices may result in more aortic regurgitation, which, by itself, has a negative effect on longer-term outcome. What is particularly concerning is that despite specific instructions to trial participants to adhere to Class I or II indications for pacemaker implantation, only 18% of implantations were actually for those indications; furthermore, despite an optimal depth of valve implantation of ≤6 mm, that was only achieved in 46% of patients. Both of these issues raise concern about the importance and relevance of the study's conclusions and potential application to widespread practice.

The discussion of this paper requires careful attention. It is detailed in the analysis of the literature and the issues involved. The conclusions and clinical perspectives are thoughtful and important. The bottom line of this set of "twofers" is the following: 1) the twofer of pacemaker implantation (and conduction defects including complete heart block) occurring in the setting of TAVR is seen to a variable degree depending in part on the specific bioprosthesis implanted; 2) whether this twofer with a combination of pacemaker implantation and TAVR is coded as a complication is important for multiple reasons—patient education, reimbursement, procedural performance, and guideline-based management of pacemaker implantation—any movement to consider a permanent pacemaker not a complication of TAVR raises many concerns and could be considered potentially disingenuous because in the surgical literature on aortic valve replacement, the need for a new pacemaker for heart block is clearly coded as a complication; 3) technical details of procedural performance are important, but optimizing device placement is difficult with this specific device, even when directives are given at study initiation; 4) future technological iterations will be focused on maximizing outcome but minimizing "events" such as conduction defects and the need for permanent pacemaker implantation. The current device will continue to iterate and to be an important device in this rapidly expanding field. The need to iterate to solve these issues requires acceptance of the fact that such issues as the need for a "twofer" with a pacemaker and a bioprosthesis should not be considered an acceptable longer-term part of TAVR but rather a need that should be addressed and overcome.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. David Holmes, Jr., Mayo Clinic, Cardiovascular Diseases and Internal Medicine, 200 First Street SW, MB 4-523, Rochester, Minnesota 55905. E-mail: holmes.david@mayo.edu.

REFERENCES

1. Petronio AS, Sinning J-M, Van Mieghem N, et al. Optimal implantation depth and adherence to guidelines on permanent pacing to improve the results of transcatheter aortic valve replacement with the Medtronic CoreValve System: the CoreValve prospective, international, post-market ADVANCE-II study. J Am Coll Cardiol Interv 2015; 8:837–46.

2. Latsios G, Gerckens U, Buellesfeld L, et al. "Device landing zone" calcification, assessed by MSCT, as a predictive factor for pacemaker implantation after TAVI. Catheter Cardiovasc Interv 2010;76:431–9.

3. Erkapic D, Kim WK, Weber M, et al. Electrocardiographic and further predictors for permanent pacemaker requirement after transcatheter aortic valve implantation. Europace 2010;12:1188–90.

4. Bleiziffer S, Ruge H, Horer J, et al. Predictors for new-onset complete heart block after transcatheter aortic valve implantation. J Am Coll Cardiol Intv 2010;3:524–30.

5. Tchetche D, Modine T, Farah B, et al. Update on the need for a permanent pacemaker after transcatheter aortic valve implantation using the CoreValve® Accutrak™ system. EuroIntervention 2012;8:556–62.

6. Van der Boon RM, Van Mieghem NM, Theuns DA, et al. Pacemaker dependency after transcatheter aortic valve implantation with the self-expanding Medtronic Core Valve system. Int J Cardiol 2013;168:1269–73.

7. Vardas PE, Auricchio A, Blanc JJ, et al. Guidelines for cardiac pacing and cardiac resynchronization therapy: the Task Force for Cardiac Pacing and Cardiac Resynchronization Therapy of the European Society of Cardiology. Developed in collaboration with the European Heart Rhythm Association. Eur Heart J 2007;28:2256–95.

KEY WORDS cardiac pacing, pacemaker implantation, TAVR